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A Personal Agents in Ubiquitous Environment: A Survey

Michael Yoseph Ricky[a*], Robin Solala Gulo[a]

[a]*Computer Science, Bina Nusantara University,Jakarta, Indonesia*

Abstract

A personal agents can be implements in various areas. The previous work has been conducted in website and mobile in corresponding to information retrieval, mobile computing, and artificial intelligence.There are different methods and framework are proposed in previous research to obtain and enhance agent's performance for better recommendations. This research aims to present comparison previous research based on personal agent in different areas for understanding of proposed framework design, architecture and its implementations. Personal agent can be applied to analyse and assisting in completing task especially for solving one purpose, and multi agents system can be applied at education, industrial, commercial, governmental, military, and entertainment applications for solving multi purposes.

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*Keywords:*Personal Agent;Collaborative System; Intelligence Agent; Adaptive Agent.

1. Introduction

People do a lot of activities every day. Not everyone can manage which activity must be done first, even confused how to do all the tasks before the specified time by utilizing the available time. A problem that cannot handled by to do list application are lack of managing priorities task and unable to identified user behavior, that caused several activity will be delayed or postponed[3].

* Corresponding author. Tel.: +62-21-5345830
E-mail address: mricky@binus.edu

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A digital personal assistant is very needed according to rapid development in technology. The current issues in Microsoft according to Bill Gates is their desire to make a personal agent application that help its user to remember, find things, and pick which things that need to be done. This application willbe implemented into all devices[1].

Today, people are attracted to get all tasks done by automatically and intelligently. An assistance offer the ability to make personal agents more helpful and assistance patterns represent a compiled form of a knowledge, which gathered all user's activities[3]. For example, Siri has been successful as a personal assistant in mobile devices. It based on user's voice to do several tasks: send messages, plan a schedule meetings, place phone calls, and etc. It is different than other traditional voice recognition application, which force you to remember keywords and its specific commands. Siri developed to understand natural speech, and intelligently asks a questions if an additional information is needed to complete a task[4]. It is uses a natural language processing to understand its user voice and intuitively make recommendations, answer questions and perform actions with a help of web service. However, its limitations relays on only available for iOS operating system.

Our life has changing since the development of technology is increasing where time, speed and accuracy is the main things. In every aspect of life, its development ranging from hardware, software and human resources to operate them. These areas required technology and it is accustomed to human behavior in applying it.

A computer has been a part of human's life which help human perform data processing and as data storage which effective and efficient. This leads the idea of research in time management issues which established by using personal agents. In academic area, a time management is the key to ensure all activities working effectively and efficiently which can performing complex tasks[3].

The objective of this research is to present comparison previous research based on personal agent in different areas that are being implemented by current research effort. This research in this field follow 2 main lines:

1. The use of personal agent in various areas and to extend method used by the current research that can be used to develop in many areas.
2. To understand proposed framework design, architecture and its implementations in which platform personal agents has been used, its methodology and best practices of implementation of personal agents.

1.1. Intelligent Software Agent

The collection properties of intelligent software agents providing features which useful:

- Autonomy
  An ability to perform actions without guidance from user.
- Learning
  An ability to create user profiles automatically and adapting based on user preferences.
- Proactiveness
  An ability to perform tasks based on user needs without direct guidance from user.
- Social ability
  An ability to interact with other agents in collecting information based on user interests.

1.2. Personal Assistant

An assistant software agent acts semi-autonomously on behalf of user, simply gathering information to create model for user interest and perform services after learning user profile when required. It has a rich information regarding to user knowledge and areas of work. The notion founded by Foundation for Intelligent Physical Agents (FIPA) [6]. According to Kumar, personal agent very useful in one or more following activities: managing user diaries, email sorting, make priority of tasks, recommend entertainment, planning travel[8].

1.3. Agent Communication Protocols

To communicate to each other, personal agent is implemented different communication protocols where can be utilize, for example:

- In-Only
  Direct communication between agents to agent.
- Request-Response
  Two way communication (request and response) between agents.
- Request-Response-Acknowledge
  Two way communication (request and response) between agents and responder send back an acknowledge message.
- Workflows
  Generalizes the sequential protocols by allowing parallel, split, merge, conditional elements, and loops.

2. Related Works

Intelligent agent implementation are varied in human life. Some of them are expected to behave like human assistant to support human activities. The agents act to collect all information and decide autonomously based on agent learning to provide a solution. The previous research of intelligent agent can be implemented in information retrieval, information filtering, personalization, mobile agents, context-aware applications and mobile computing.This research surveyed the previous work on intelligent agent that have been implemented into several areas.

2.1 Subhash Kumar, et al[10]

Dealing with real-world semantic web as proposed in this research, allowing collaboration with recommender and peer agents. The architecture of this model lays on information manipulation available using Java Agent development Environment and Java Expert System Shell. Information are ranging from axioms, different rules semantic markup language over the semantic web knowledge. The results of this research, a personal agent developed in this research needs an improvement and additions in semantic web problem. The relation between concepts of intelligent agents and semantic web are huge and the research in this fields need to be developed in the future.

2.2 Alain Macaire, et al[11]

This research apply personal agent in mobile devices since the issue is service roaming for mobile telecommunication. However, experimenting mobile agents and the VHE for mobile user servicessuch as electronic commerce is quite challenge. GEMPLUS (a research lab) has developed the concept of Personal Agent Manager (PAM) which allows user to manage their agents. From any terminal, roaming users are able to create, launch and retrieve mobile agents. PAM is built on top of Java Card based application that provide terminals with the personalization part of users.

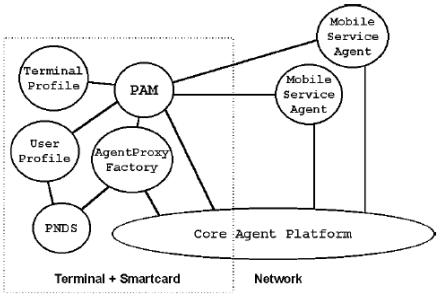

Figure 1. Proposed Architecture Personal Agent Manager for Mobile Users.

The architecture in figure 1 allows user mobile to manage personal environment and user has an ability to personalize based on various information provided.

2.3Hajime Kusu, et al[12]

This research intend to find an easy way to communication for human which proposed a network design using personal area and home network. The architecture developed network configuration managements and using personal network to develop personal agent system prototype and verified its basic operation.

2.4I.B Crabtree, et al[13]

The research focus on providing services using a common user profile by proposed framework. User profiling is the main intention of this research where personalization of agent-based services and benefit obtained from its use. User profile gather information from observation of user reads and tracks user interest from time to time. The implementation involving common user profile which accessible to all agents, provide privacy and security, facilitate collaboration between agents and group of users.

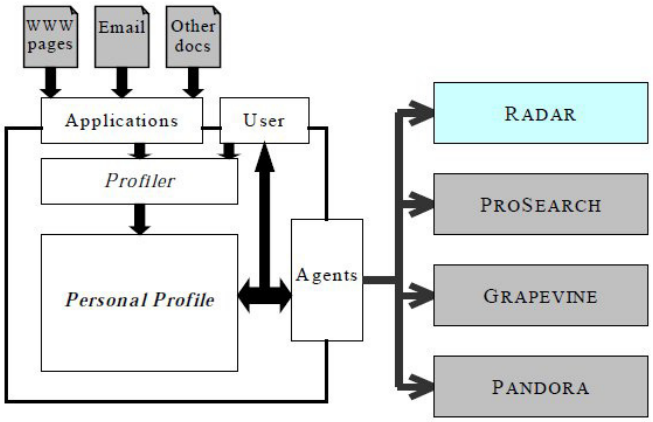

Figure 2. Proposed Framework for Personal Agents.

Framework for the development of personal agents will provide range of capabilities, and stored information into database (Radar, Prosearch, Grapevine, and Pandora). A capabilities may lacking in any one current personal agent. Involving a profiler agent with privacy issue clearly addressed to enhance not only interaction between agents but also range of application for personal agents.

2.5Debbie Chyi, et al[14]

In this research, author proposed mobile agent system which use information retrieval service. The agent retrieves information from internet and uses context-aware to manage gathered data based on user preferences, consists of user location and schedules. Personal agent system developed in windows and a waveLAN network for communicating wirelessly between two machines.

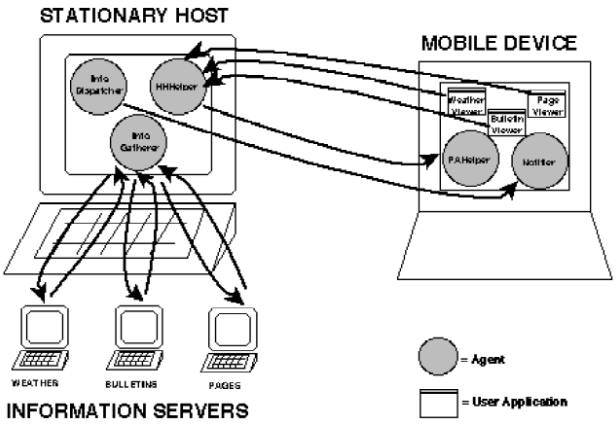

Figure 3. Personal Agent Architecture in Mobile devices

2.6 Nathaniel Good, et al[15]

The authors proposed collaborative filtering that focus on identification of user similar behavior, opinion, group of user recommendation to produce recommendation that either user or agents produce alone. The objectives of this research is to combine information filtering by identifying which items user will select. Collaborative filtering used to determine the value of items according to opinions other user and community. The data will be stored into database.

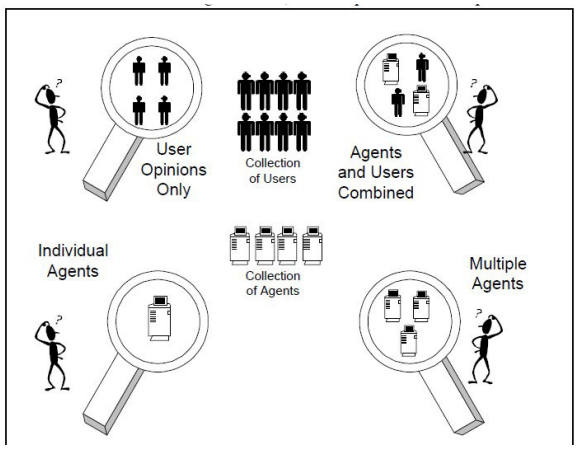

Figure 4. Collaborative Filtering Agent Architecture

In testing phase, agent will used user opinions information, information retrieval, and personal agent bot using TF-IDF vector. Based on research authors concluded that collaborative filtering better than single agents, many agents better than one, and collaborative filtering of users better than combination of agents.

2.7Patrice Roy, et al[16]

In mobile agents, it is needed to create a personal agents that understand user needy and this research proposed an architecture according to dynamic nature of agent network issue. An intelligent space that is main topic of this research is to find a contextual applications that are distributed, autonomic and independent to specialized components.

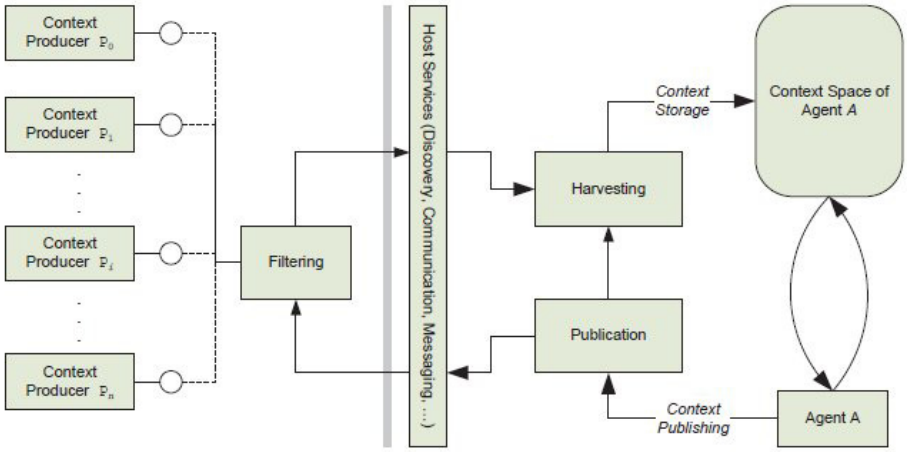

Figure 5. Overview of Agent's Context-dependency Management Cycle

2.8 Anandeep S. Pannu, et al[17]

An author proposed an architecture for personal agents that learn user preferences, information filtering. The agent will find a user interest and request a proposal based on user interest. For this task, a large number of irrelevant documents and the proportion of relevant documents is relatively small. Therefore, a classification for relevant documents are critical. An information retrieval and neural network techniques were utilized to learn user preferences. This filtering based on model developed and it has learning activities. User will be sent relevant or irrelevant documents by email or pop-up window, then a user can judges the articles or documents filtered.

Based on this research, Learning Personal Assistant learns a model of the user's preferences to notify a user when relevant information becomes available. The Information Retrieval based approach to get information available and Neural Network based approach uses Boolean zero-one vector for document and TF-IDF.

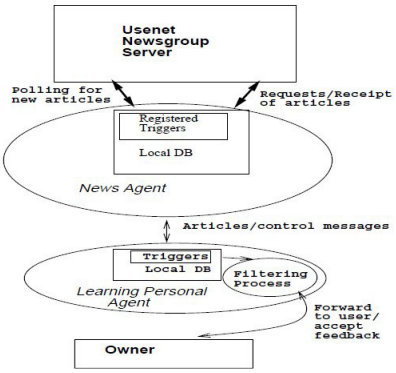

Figure 6. Learning Personal Agent and Environment

2.9 Ali R. Montazemi, et al[18]

A variety of data sources that connected in communication networks needs an access and analyze large volume of data to support decision making process. The effective decision making is important to provide benefits. Therefore intelligent agents expected to act like human and support complex decision by automatically perform specific set of tasks and anticipate information requirements.
In this research, fuzzy set method is used for the assessment of buddy agents in system environment to support complex decision problem. In summary, Agent technology is effective to reduce decision information by delegating tasks to agent systems, which saving not only time and energy, but increasing the value of work.

2.10 ChandramohanDhasarathan, et al[19]

This research focused on secrecy on cloud environment using intelligent agent which store valuable personal data. For a cloud provider, data and information are critical to maintain. The problem is, current user feels insecure to current technology used. Therefore, an author proposed a hybrid algorithm for authentication techniques for user's privacy for detection and prevention to ensure users data secrecy and develop trust on service providers. This algorithmic will act intelligently as a privacy preserving. The need of modular approach to maintain secrecy of cloud user is needed since it is restricted to organizations agenda.

3. Comparison

In this section, we make a comparison between all papers in the review of personal agents. This study consider to following factors: platform used in implementation of personal agent, type of personal agents, the objective of surveyed papers, the proposed methodology, personal agents methods or characteristics, and experimental result or lesson learned.

Table 1. Personal Agent Comparison

Title	Platform	Single/Multi Agents	Objective(s)	Proposed Methodology	Method of Personal Agents	Experimental Results / Lessons Learned
A personal agent application for the semantic web	Web	Single	Dealing with real-world semantic web mark-up	The Java Expert System Shell (JESS)	Learning and social-ability	Semantic web can be used to develop ontology based B2B marketplaces and for intelligent personal assistant
A Personal Agent Manager for Mobile Users	Mobile	Single	Implementation of PAM in mobile devices	Personal Agent Manager	Learning	PAM allows mobile users to manage their own mobile agents to provide a personal environment and personalisation
A Personal Agent that Supports Communication in the Ubiquitous Communication Environment	Website	Single	Creating an ubiquitous communication environment in personal area networks	Communicating XML and HTTP in personal area network	Pro-activeness	Proposed a PA function can supports communication in the ubiquitous communication environment

Adaptive Personal Agents	Website	Single	framework for personal agents providing services using a common user profile	Information retrieval based on website pages, email and other documents.	Learning	Framework provide personal agents with a range of capabilities that different to current personal agent
An Infrastructure for a mobile-agent system that provides personalized services to mobile devices	Mobile	Single	Creating a mobile-agent system	Information retrieval, information filtering, mobile computing	Social Ability, Autonomy	PA weakness dependent on mobility and enhanced services
Combining collaborative filtering with personal agents for better recommendations	Website	Single	Proposed a Collaborative Filtering	Individual information filtering agents, Doppelganger bots using IDF vector,ripperbot, the genrebots, a mega-genre bot	Pro-activeness	Collaborative filtering have better result than single agents.
a Distributed Architecture for Micro Context-Aware Agents	Mobile	Single	An architecture of open intelligent space	a distributed multi-level architecture	Autonomy	Micro approach using distributed Agents are important in open intelligent space
A Learning Personal agent for Text Filtering and Notification	Website	Single	A reusable agent that learns a model of the user's preferences	Information Retrieval and Neural Network techniques	Learning	Information Retrieval based approach is the most promising as a model for user preferences than the Neural Network based
a Methodology for the Assessment of Buddy-Agents	Website	Multi	Intelligent agents to support complex decision	Fuzzy-set methodology	Autonomy	Agent technology is believed to be an effective way to reduce decision-makers' information overload
A multi-agent approach: To preserve user information privacy for a pervasive and ubiquitous environment	Website	Multi	To propose a secure model	A hybrid authentication technique	Autonomy and Pro-activeness	modular framework proposed dependant to maintainsecrecy and policy

4. Conclusions

As we make a comprehensive study in this paper, we noted that personal agent can be applied to analyze and assisting in completing task especially for solving one purpose, and multi agents system can be applied at education, industrial, commercial, governmental, military, and entertainment applications for solving multi purposes.
Thus the overall agent design guides the user in terms of managing, reasoning, planning, learning and improving its performance to user preference.
Till now there is no optimal suggested solution that could be considered as standard mechanism for method of agent, but either personal and multi agent need an interface to interact with human/user.
For this reason and others we intended to make our work as a survey paper to make it easier for everyone interested in working on this field gathering as many information and references as we could introduced here. We plan to extend a personal agent that have the ability to learn user habit for future work. We also intend to analyze the performance evaluation to personal agent model that exist today and our future work.

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